Synthesis of Adaptation Options for Coastal Areas

COASTAL TRAINING PROGRAM
Tijuana River

Overview of potential climate change impacts on estuarine systems

- Climate change stressors:
  - sea level rise
  - increases in water temperatures
  - altered timing of seasonal changes
  - increases in air temperatures
  - changes in precipitation
  - elevated atmospheric CO_2
  - changes in storm intensity

- Vulnerable areas include ocean shores and estuarine shores; wetlands; and estuarine open water

The potential impacts on estuarine systems are numerable

- Coastal change (erosion, landward migration)
- Change in coastal water quality
- Habitat changes (both structural and functional)
- Altered winter-spring discharge rates
  - leading to increased erosion and runoff
  - flooding
  - changes in volume and timing of runoff and sediment distribution
- Increased intensity of coastal storms

Adaptation options for coastal areas

- Maintain/restore wetlands
- Maintain sediment transport
- Preserve coastal land/development (including infrastructure)
- Maintain shorelines utilizing “soft” measures
- Maintain shorelines utilizing “hard” measures
- Invasive species management
- Preserve habitat for vulnerable species
- Maintain water quality
- Maintain water availability

Adaptation Option	Climate Stressor Addressed	Additional Management Goals Addressed	Benefits	Constraints	Examples
Allow coastal wetlands to migrate inland (e.g., through setbacks, density restrictions, land purchases[8])	Sea level rise	Preserve habitat for vulnerable species; Preserve coastal land/development	Maintains species habitats; maintains protection for inland ecosystems	In highly developed areas, there is often no land available for wetlands to migrate, or it can be costly to landowners	Buzzards Bay, Massachusetts[9]

Weighing the options

- Some adaptation options may:
  - apply directly or indirectly to multiple management goals (ex: allowing wetlands to migrate inland will not only maintain wetlands, but could also directly address management goals of maintaining water quality and preserving habitat for vulnerable species)
  - contribute to the protection of human infrastructure, while causing detrimental effects to natural systems (ex: shoreline hardening could adversely affect wetlands by preventing sediment transport essential to that ecosystem)
- Since options have individual benefits for shoreline and coastal protection, it may be beneficial to develop a comprehensive shoreline plan
  - This would allow managers to take into consideration priorities and tradeoffs and consider implementing different options in different areas according to which resources are most in need of protection

Hard vs. Soft measures

- "Soft" measures aim to develop living shorelines through beach nourishment, planting dune grasses, marsh creation, and planting submerged aquatic vegetation (SAV)
- Hardening techniques include constructing bulkheads, seawalls, revetments, and breakwaters, or reinforcing dikes and headlands
  - techniques often aim to preserve existing development and infrastructure or protect land available for future development or infrastructure
  - While these options may provide immediate remediation, they may not be sustainable in protecting coastal land in the long term

-- Many of these adaptation options have potential negative impacts on habitats and ecosystems as well, including wetland loss where migration is blocked by hard structures --

Moving forward in the face of uncertainty

- Some options are potentially difficult and costly to implement
- There may be some easy solutions; the sooner they are completed, the easier and perhaps cheaper they will be compared to the costs of inaction
- Land managers and property owners will be faced with difficult and potentially costly tradeoffs and actions
- More work is needed to evaluate the feasibility of options, better define the cost-effectiveness, and provide additional guidance for land managers
- Decision-makers can, nevertheless, begin to take steps toward adapting to climate change

Transportation Planning Incorporating Wetland Preservation in Houston-Galveston, Texas

Management Goal: Management Goal A: Maintain/restore wetlands

Climate Stressor Addressed: Sea level rise

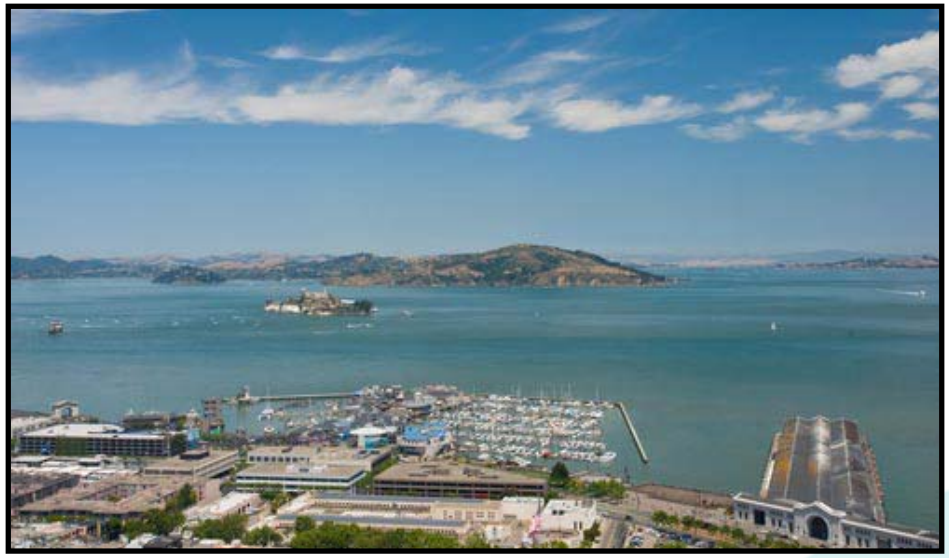
The Houston-Galveston Area Council, a voluntary organization of local government officials and agencies, developed the 2035 Regional Transportation Plan, a long-range system plan that aimed to improve transportation in the region. One of the major goals of the plan was to alleviate some of the environmental impacts of transportation on habitats. The plan identified eight ecological zones within the region, paying particular attention to wetlands, which not only provide rich ecological habitats, but also protect shoreline areas from erosion and serve as buffers from flooding and coastal storms.

Source: SAP 4.7, Chapter 5

CLIMATE READY ESTUARIES

EPA

Vulnerability Assessments



*Above, the **San Francisco Estuary Partnership** assessed climate change vulnerability focused on the sensitivity of salt marsh ecosystems to projected climate change effects.*

- **Charlotte Harbor National Estuary Program** assessed storm surge and improved land use decisions, infrastructure investment, and conservation management
- **The Partnership for the Delaware Estuary** estimated the value of losses in natural capital from climate change and determine how these losses might be reversed or improved through restoration
- **Massachusetts Bays Program** conducted a climate change vulnerability assessment in partnership with Massachusetts Office of Coastal Zone Management's StormSmart Coasts Program, which addresses the impacts of climate change on infrastructure and coastal property

Adaptation Planning

*Above, the **City Council of Punta Gorda's** adaptation planning included three successful public workshops. These workshops built upon a pre-meeting survey and included interactive exercises to engage the public in helping to consider and prioritize vulnerabilities and adaptation strategies.*

•**Indian River Lagoon National Estuary Program** is working with the City of Satellite Beach to include goals and policies addressing sea level rise in the city's Comprehensive Growth Management Plan

•**The Long Island Sound Study** in partnership with ICLEI is preparing a coastal adaptation plan for the town of Groton. The main focus of this effort will be facilitating workshops to engage representatives from federal, state, and municipal governments to explore their roles in adaptation efforts and define strategies for maximum benefit

Lessons learned from working with coastal communities

- Start small
- Move forward with the data you have
- Involve the community
- Coordinate with government entities
- Get the attention of elected officials
- "No regrets strategies" and adaptive management can provide immediate local or regional benefits, as well as reduce future impacts under a range of climate change effects
  - adopting rolling easements
  - creating new waterfront parkland that serves as a buffer to built-up areas
  - strengthening building codes in storm surge areas
  - developing model ordinances

For more information

***Visit* Climate Ready Estuaries (CRE)**

www.epa.gov/cre

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